# TYPE TBL

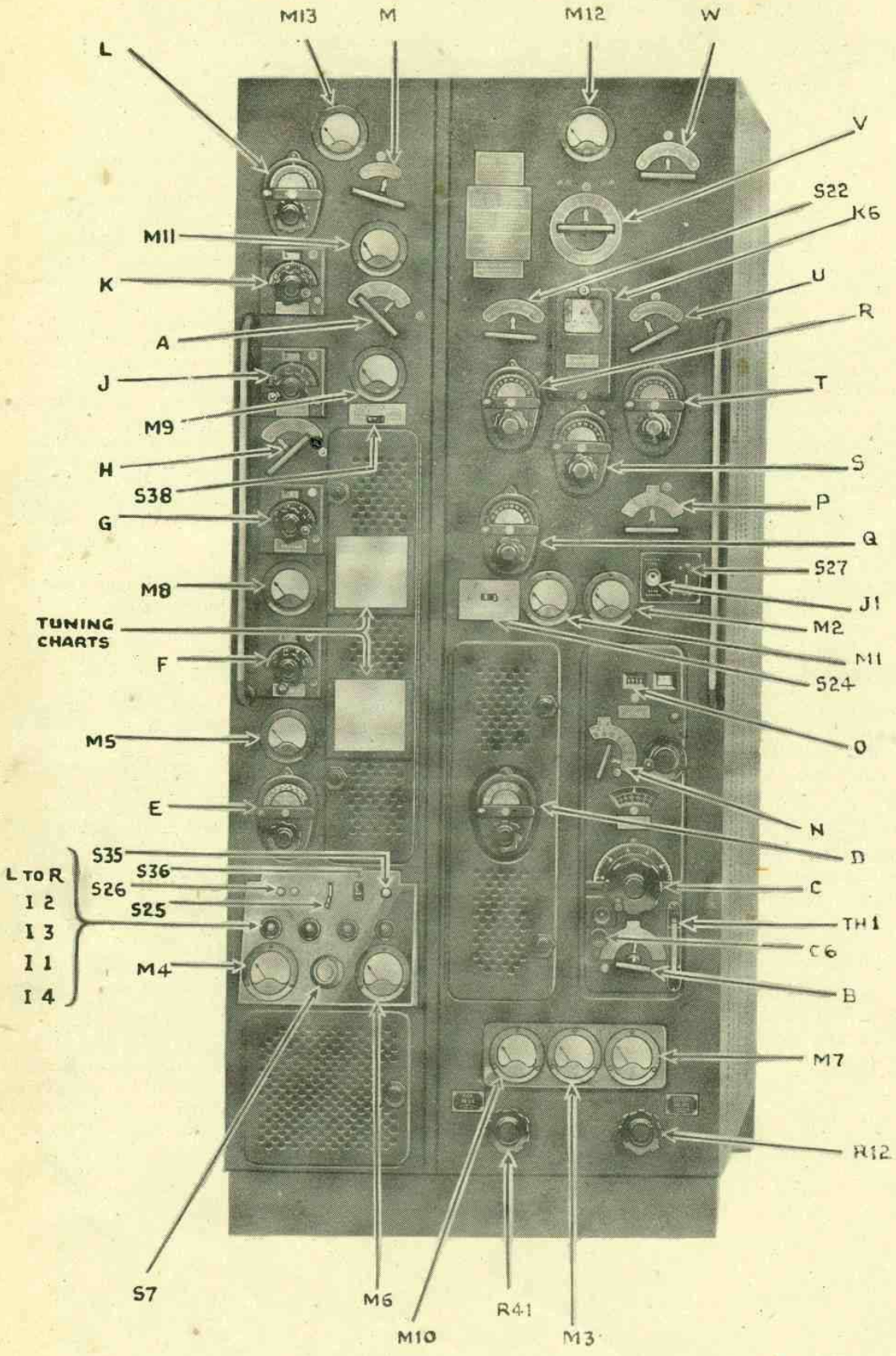



FIG. a

# TYPE TBL



1. General Details.

Transmitter TBL is an American set, designed and manufactured for ship use.

| | | |
|---|---|---|
| Where Fitted. | Fleet Destroyers and Frigates. | |
| Frequency Range. | I/F | 175 - 600 Kc/s. |
| | H/F | 2 - 18.1 Mc/s. |
| Type of Emission. | I/F | C.W. or M.C.W. |
| | H/F | C.W. |
| | (Note:- | Transmitter is wired for the addition of a Modulator Unit for R/T transmissions, but, as it is not fitted in H.M. Ships, it is not considered in this description). |
| Power Output (Maximum) | C.W. | 200 watts. |
| | M.C.W. | 100 watts. |
| | Power output is continuously adjustable down to one quarter power. | |
| Power Supply. | 230 volts D.C. from ships mains supply - a Motor Generator Unit. Maximum load 6.2 kw. Motor Generator Unit provides 220 volts 60 cycle for filament heating, 1000 volts and 2000 volts for H.T. and screen grid supplies and, 250 volts for grid bias supplies. Control circuits are operated from the ships mains. | |
| Aerial. | Ships Main Aerial. | |
| Keying. | The keying relay is capable of operation at speeds up to 100 words per minute. | |
| Associated Wavemeter. | Wavemeter Outfit CN. | |

2. Construction.

The complete equipment consists of the following units. To enable a rough appreciation to be obtained of the space required approximate dimensions have been given.

| | | |
|---|---|---|
| (a) Transmitter Unit. | Height | 72 inches. |
| | Width | 32 inches. |
| | Depth | 24 inches. |
| (b) Motor Generator. | Length | 61 inches. |
| | Width | 17 inches. |
| | Height | 20 inches. |
| (c) Filter Unit. | Height | 18½ inches. |
| | Width | 16½ inches. |
| | Depth | 9 inches. |
| (d) Magnetic Controller. | Height | 21 inches. |
| | Width | 13 inches. |
| | Depth | 12 inches. |

The last two units are mounted on a bulkhead.

3. Transmitter Unit.

In order to simplify tuning procedure, each control on the front panel of the transmitter is marked by a letter in addition to a name plate, stating its function. To further facilitate differentiation between the controls that effect the I/F and H/F portions of the set, the former have their associated identity plates with a blue background, whereas the latter are coloured in green.

Reference should be made to Figure "A" when studying the following list of Controls and Components fitted on the front panel.

The control identity letters and component descriptions are the same as printed on the identity plates on the transmitter. The identity shown in brackets is the same as allocated to the components in the sketches depicted in the Handbook.

Control "A"
(Operates switches S4, S5, S6, S8, S10, S11, S14, S15 and S37).

I/F - H/F Transfer Switch. For transferring the various circuits of the Transmitter for operation on either I/F or H/F.

Control "B" (S1)

H/F M.O. Range Switch. Two pole eight way switch for selecting the necessary fixed condenser and tuning coil taps to cover the eight frequency bands of the M.O. circuit.

# TYPE TBL

| | |
|---|---|
| Control "C" (L1) | H/F M.O. Tuning Inductance. Fine tuning of M.O. tuned circuit. |
| Control "D" (C17) | H/F Doubler Circuit Tuning Condenser. To tune the Doubler Circuit to the second harmonic of the M.O. tuned circuit. |
| Control "E" (C28) | H/F 1st Intermediate Amplifier Tuning Condenser. Adjusts the variable condenser to tune the anode circuit of the 1st Intermediate Amplifier when Control "A" is in the "H/F" position. |
| Control "F" (C36,L16) | H/F 2nd Intermediate Amplifier Tuning Control. Adjusts the variable condenser and inductance to tune the anode circuit of the 2nd Intermediate Amplifier when Control "A" is in the H/F position. |
| Control "G" (C47,L23) | H/F Power Amplifier Tuning Control. Adjusts the variable condenser and inductance to tune the anode circuit of the Power Amplifier stage when Control "A" is to H/F. |
| Control "H" (Operates switches S9, S12, S13 and S16). | H/F Range Switch. Two positions, 2 - 4.1 Mc/s and 4 - 18.1 Mc/s. Control the frequency coverage of the tuned anode circuits of the 1st and 2nd Intermediate Amplifier and Power Amplifier Stages. For details of operation see the technical description of the circuits concerned. |
| Control "J" (C50) | H/F Antenna Coupling Condenser. Adjusts the coupling between the H/F Power Amplifier tuned anode circuit and H/F aerial circuit. |
| Control "K" (L25) | H/F Antenna Inductance. Adjusts the aerial tuning inductance. |
| Control "L" (C51) | H/F Antenna Capacitor. Adjusts the variable tuning condenser, working in conjunction with Control "K", to tune the H/F aerial tuned circuit. |
| Control "M" (S17) | H/F Antenna Feed Switch. Two positions, current or voltage feed, places the H/F aerial tuning condenser and H/F aerial tuning inductance in series or parallel respectively. |
| Control "N" (S23) | I/F M.O. Range Switch. Two pole seven way switch to select the appropriate fixed condenser combination and inductance coil tapping to cover the seven frequency bands of the I/F M.O. tuned circuit. |
| Control "O" (L9) | I/F M.O. Tuning Variometer. For fine tuning of the I/F M.O. Tuned circuit. |
| Control "P" (S20, S21). | I/F Range Switch. Two ganged two pole five way switches. S21 selects the appropriate fixed condensers combination and inductance coil tapping to cover the five frequency bands of the I/F Intermediate Amplifier tuned anode circuit. S20, in addition to performing the same function as S21, but for the tuned anode circuit of the I/F Power Amplifier stage, varies the value of the aerial coupling coil (L29A) as applicable to the frequency band, in use. |
| Control "Q" (L15) | I/F Intermediate Amplifier Tuning Variometer. For fine tuning the anode circuit of the I/F Intermediate Amplifier stage. |
| Control "R" (L22) | I/F Power Amplifier Tuning Variometer. For fine tuning the anode circuit of the I/F Power Amplifier stage. |
| Control "S" | I/F Antenna Coupling Coil. To control the degree of coupling between the I/F Power Amplifier and Aerial circuits, by varying the mutual coupling between the Power Amplifier coupling coil (L29A) and Aerial coupling coil (L29). |

Control "T" (L27) — I/F Antenna Tuning Variometer for fine tuning the I/F aerial circuit.

Control "U" (S34) — I/F Antenna Series Capacitor Switch. To bring a fixed condenser (C92) in series with the I/F tuned aerial circuit for use when operating on or near the high frequency end of the I/F band on an unusually high capacity aerial.

Control "V" (S19) — I/F Antenna Inductance Switch. Selects the appropriate tap on the I/F aerial tuning coil for the frequency in use.

Control "W" (S18) — Antenna Transfer Switch. Changes over the aerial to the H/F tuned aerial circuit or I/F tuned aerial circuit as requisite. A third position connects the aerial to a receiver when it is desired to use the main aerial for reception purposes.

Meters.

| | |
|---|---|
| M1 | H/F Master Oscillator Screen Grid Milliammeter. |
| M2 | Master Oscillator Anode Milliammeter. |
| M3 | Master Oscillator Anode Voltmeter. (Indicates output of 1000 volt Generator). |
| M4 | Line Voltmeter (Shows supply mains voltage). |
| M5 | First Intermediate Amplifier Anode Milliammeter. |
| M6 | Grid Bias Voltmeter. (Indicates Grid Bias Generator output). |
| M7 | Filament Voltmeter. |
| M8 | Second Intermediate Amplifier Anode Milliammeter. |
| M9 | Power Amplifier Grid Milliammeter. |
| M10 | Anode Voltmeter. (Indicates output of 2000 volt Generator). |
| M11 | Power Amplifier Anode Milliammeter. |
| M12 | I/F Aerial Ammeter. |
| M13 | H/F Aerial Ammeter. |

Switches.

S7. — Phone - C.W. - M.C.W. Switch. Three position switch to select the mode of transmission required.

S22. — Tune-Operate Switch. Three positions. "Step 1". Disconnects Intermediate and Power Amplifier H.T. supplies for tuning Master Oscillator tuned circuits. "Step 2". Inserts resistances (R23, R37) in series with 2000v. supply to apply reduced H.T. to Intermediate and Power Amplifier stages for tuning purposes. "Operate". Connects Intermediate and Power Amplifier stages to normal operating H.T. potentials.

S24. — Emergency Switch. Cuts off all power to the equipment for use in an emergency, can also be used to stop the Motor Generator if the Start-Stop Switch (S26) fails to function. As oven heating circuits are broken by this switch, time must be allowed for the temperature to become stabilised again, after it is remade.

S25. — Remote-Local Switch. Transfers the control of the transmitter from Local Control to Remote Control. When in the "Remote" position, the set can be controlled either locally or from the Remote Control position.

S26. — Start-Stop Switch. Used to start or stop the Motor Generator. The machine can be stopped by this switch even when the Remote Control Start-Stop Switch is to "Start". The switch must be in the "Start" position before the Motor Generator can be controlled from the Remote Control Position.

S27. — Test Key. Three positions. Centred, switch is broken. Raised, switch remains on, Lowered, switch will remain depressed only while pressure of hand is applied. It energises the Keying Relay (K6) and is used for tuning.

S35. — Overload Relay Reset Button. When pressed completes supply to reset coils of overload relay. Used to reset overload after it has operated.

S36. — Line Voltage Normal - High Switch. Protects the oven circuits against unduly high line voltages by bringing in additional series resistances (R151, R152).

S38. — Power Amplifier Grid Current Control Switch. Inserts resistance (R21) into the Grid Circuit of the Power Amplifier Valves to reduce the Grid Current. Normally switch is left in the Raise position, i.e. resistance short circuited. If the current exceeds 90 milliamps, as read on the Power Amplifier Grid Current Milliammeter (M9), the switch is set to its lower position.

Indicating Lamps.

| | | |
|---|---|---|
| I1. | Heater Power Indicating Lamp (Amber). | Indicates power is being applied to the oven heating circuits. |
| I2. | Motor Solenoid Indicating Lamp (Blue). | Indicates power is being applied to the Starting Contactor (K4). |
| I3. | Plate Voltage Indicating Lamp (Red). | Indicates power is being applied to the Field Contactor (K3). |
| I4. | Bias Voltage Indicating Lamp (Green). | Indicates output voltage is being obtained from Bias Generator. |

Miscellaneous.

| | | |
|---|---|---|
| R12. | Filament Voltage Rheostat. | For adjusting Filament voltage to correct value, shown by Filament Voltmeter (M7). |
| R41. | Plate Voltage Rheostat. | Controls current through Shunt Field of High Voltage Generator, this in turn controls anode potential of all stages except Master Oscillator Valves. Used to control power output of transmitter. |
| C6. | H/F M.O. Calibration Condenser. | Used to adjust the M.O. tuned circuit to allow for small changes in dial calibration due to ageing of parts or changes in the characteristics of the H/F M.O. valve. |
| J1. | Frequency Meter Audio Output Jack. | For plugging in Headphones when tuning by "Heterodyne Method". |
| K6. | Keying Relay. | Completes necessary circuits to enable transmitter to oscillate, controlled by Test Key (S27) or Morse Key in Remote Control Position. |
| TH1. | M.O. Temperature Thermometer. | Indicates temperature of oven which contains all frequency determining components of H/F and I/F Master Oscillator Circuits. |

4. Operation.

The following instructions are intended to detail all that is necessary to bring the transmitter to the "Ready to transmit" condition", assuming that the set has previously been tuned and that the calibration book or card is available.

Before attempting to apply power to the set, it is important that the tuned circuits should be correctly adjusted to the desired frequency, this is necessary to avoid overloading the valves and possibly damaging them, when the key is pressed.

(a) H/F. (2,000 - 18,100 Kc/s).

Adjust the following controls in accordance with the calibration book :

1 Control "B" - H/F M.O. Range Switch.
2 Control "C" - H/F M.O. Tuning Inductance.
3 Control "D" - H/F Doubler Circuit Tuning Condenser.
4 Control "E" - H/F 1st Intermediate Amplifier Tuning Condenser.
5 Control "F" - H/F 2nd Intermediate Amplifier Tuning Control.
6 Control "G" - H/F Power Amplifier Tuning Control.
7 Control "H" - H/F Range Switch.
8 Control "J" - H/F Antenna Coupling Condenser.
9 Control "K" - H/F Antenna Inductance.
10 Control "L" - H/F Antenna Capacitor.
11 Control "M" - H/F Antenna Feed, Current - Voltage Switch.
12 Power Amplifier Grid Current Control Switch (S38).

Set the following controls to their H/F positions.

Control "A", H/F - I/F Transfer Switch.
Control "W", Antenna Transfer Switch.

Set the Phone-C.W.-M.C.W. Switch to "C.W.", the Remote-Local Switch to "Local" and, the Tune-Operate Switch to "Operate".

(b) Starting Up.

Press the "Start" Button of the Start-Stop Switch, the motor-Generator should now start.

Adjust the Filament Voltage Rheostat until the reading on the Filament Voltmeter is 10 volts. The M.O. Plate Voltmeter should now be showing 950 volts.

Adjust the Plate Voltage Rheostat for the voltage required to be shown on Plate Voltmeter commensurate with the desired power output.

Change the Remote-Local Switch to the Remote position, the Motor Generator will now stop.

The operator in the remote position can now start the Motor Generator by making his Control Switch and can transmit by pressing his Morse Key.

(c) I/F. (175 - 600 Kc/s).

Adjust the following controls in accordance with the calibration book :

1 Control "N" - I/F M.O. Range Switch.
2 Control "O" - I/F M.O. Tuning Variometer.
3 Control "P" - I/F Range Switch.
4 Control "Q" - I/F Intermediate Amplifier Tuning Variometer.
5 Control "R" - I/F Power Amplifier Tuning Variometer.
6 Control "S" - I/F Antenna Coupling Coil.
7 Control "T" - I/F Antenna Tuning Variometer.
8 Control "U" - I/F Antenna Series Capacitor Switch.
9 Control "V" - I/F Antenna Inductance Switch.
10 Power Amplifier Grid Current Control Switch.

Set the following controls to their I/F positions.

Control "A" - H/F - I/F Transfer Switch.
Control "B" - Antenna Transfer Switch.

Set the Phone-C.W. M.C.W. Switch to "C.W." or "M.C.W." according to the mode of transmission desired, the Remote Local Switch to "Local" and the Tune-Operate Switch to "operate".

(d) Starting Up. Press the "Start" button of the Start-Stop Switch, the Motor Generator should now start.

Adjust the Filament Voltage Rheostat until the Filament Voltmeter shows 10 volts.

The M.O. Plate Voltmeter should now be showing 950 volts. Adjust the Plate Voltage Rheostat for the voltage required to be shown on the Plate Voltmeter commensurate with the desired power output.

Change the Remote-Local Switch to the "Remote" position, the Motor Generator will stop.

The operator in the remote position can now start the Motor Generator by making his Control Switch and can transmit by pressing his Morse Key.

5. Tuning.

(a) General.

The transmitter is designed for tuning by the "Heterodyne Method", to enable tuning to be readily achieved with the operator standing in a convenient position in front of the set, a socket (J1) is fitted in the front panel of the transmitter into which headphones can be plugged. This socket should be connected to the output of the Heterodyne Detector Valve of Wavemeter G73.

A capacity coupling is taken from the Grid of the H/F 1st Intermediate Amplifier, or, from the Screen Grid of the I/F Master Oscillator, and fed to the R/F Input socket on Wavemeter G73.

The R/F input is mixed with the R/F oscillations of the Oscillator Stage of the G73 and the beat is detected by the Heterodyne Detector Stage and passed on to the headphones being worn by the operator.

The majority of the tuned circuits in the transmitter are capable of being effectively tuned to unwanted harmonics of the desired frequency. In order to eliminate the possibility of erroneously tuning to one of these incorrect harmonics, it is essential to refer to the calibration curves printed in the Handbook and to apply the adjustments given, for the particular frequency desired, to all tuning controls before attempting to tune through finally to the Wavemeter setting.

It should be borne in mind that, for efficient frequency stability, the oven should be held at a working temperature of 60°C, to achieve this the heater circuits are normally left on when the set is likely to be used, but, if starting from "cold", three hours should be allowed for them to become stable.

(b) H/F. (2 - 18.1 Mc/s).

1. Adjust Controls "B" to "G", tabulated in H/F operating instructions, to the setting obtained by reference to the calibration curves in the Handbook.

2. Set Control "J" to approximately zero dial reading.

3. Set the Power Amplifier Grid Current Control Switch to the "raise" position.

4. Set the Phone-C.W.-M.C.W. Switch to "C.W."

5. Set the Tune-Operate Switch to "Step 1".

6. Set the Remote-Local Switch to "Local".

7. Set Controls "A" and "W" to their "H/F" positions.

8. Start the Motor Generator by pressing the "Start" button and adjust Filament Voltage to 10 Volts by the Filament Voltage Rheostat.

9. Switch on Wavemeter G73, set the appropriate frequency by setting the Range Switch and Variable Condenser in accordance with the readings given by the Wavemeter Calibration Book (see note under). Set the change over switch to "C.W. Het. Det.". Set the carrier level to 120 microamps on the meter.

Note:- Frequency to be set on wavemeter. It must be clearly appreciated that the wavemeter is coupled to the Grid of the H/F. 1st Intermediate Amplifying Valve and that the frequency at this point will be the output frequency of the Master Oscillator Unit, not the frequency of the Master Oscillator Tuned Circuit, and not necessarily the desired transmitter output frequency as doubling takes place in the H/F M.O. Doubler Circuit and may also occur in later stages.

In order to ascertain the correct frequency to set on the wavemeter, reference must be made to the tuning curve for the H/F. M.O. Tuned Circuit, page 205 in the Handbook. From this can be seen the actual output frequency of the Master Oscillator Unit.

Examples.

| Desired Frequency. | Output Frequency of M.O. Unit and Frequency to which Wavemeter should be adjusted. |
|---|---|
| 3,200 Kc/s | 3,200 Kc/s |
| 6,400 Kc/s | 3,200 kc/s |
| 12,800 Kc/s | 3,200 Kc/s |
| 16,400 Kc/s | 4,100 Kc/s |

10. Press Test Key and tune the H/F Doubler Circuit, Control D, for a maximum reading in the H/F M.O. Plate Current Meter (M2). This step is necessary in order to produce a reasonably strong beat note in the Headphones. Tune H/F. M.O. Tuning Inductance, Control C, and the H/F. Doubler Circuit, Control D, in step, maintaining the maximum reading in the H/F. M.O. Plate Current Meter, until a "dead space" is obtained in the Headphones.

11. Place the Tune-Operate switch in its "Step 2" position.

12. Tune the H/F Doubler Circuit, Control "D" for maximum reading in the 1st Intermediate Amplifier Plate Current Meter (M5).

13. Tune the H/F 1st Intermediate Amplifier Tuned Circuit Control "E" for maximum reading in the 2nd Intermediate Amplifier Plate Current Meter (M8).

14. Tune the H/F. 2nd Intermediate Amplifier Tuned Circuit, Control "F" for minimum reading in the 2nd Intermediate Amplifier Plate Current Meter (M8).

15. Tune the H/F Power Amplifier Tuned Circuit, Control "G" for a minimum reading in the Power Amplifier Plate Current Meter (M11).

16. Place the H/F. Antenna Feed Switch, Control "M" to "Current Feed" and adjust the H/F Antenna Inductance, Control "K" and the H/F Antenna Capacitor, Control "L" until maximum Antenna Current is obtained, the H/F. Antenna Coupling Control "J" may have to be increased from zero to obtain a reading.

If unable to obtain any indication in the H/F Antenna Current Meter, shift the H/F Antenna Feed Switch to its "Voltage Feed" position and follow the same procedure as in the preceding paragraph.

As soon as a reading has been obtained in the H/F Antenna Current Meter, adjust Controls "K" and "L" to obtain a maximum.

17. Place the Tune-Operate Switch to "Operate" and adjust the Plate Voltage Rheostat to read 2000 volts in the Plate Voltmeter (M10).

18. Increase Control "J" and readjust Controls "K" and "L" for maximum Antenna Current and not exceeding a reading of 350 milliamps in the Power Amplifier Plate Current Meter.

Note :- After each and every aerial adjustment, operation (15) should be repeated

19. Note the reading shown by the Power Amplifier Grid Current Meter, if it exceeds 90 milliamps, move the P.A. Grid Current Control Switch to its "Lower" position.

Care must be exercised to ensure that the aerial circuit is being tuned to the required output frequency and not to a harmonic. Reference to the table of typical dial settings, given in the Handbook, should enable easy differentiation between true and false settings.

(c) I/F. (175 - 600 Kc/s.)

1. Adjust controls "N" to "R", tabulated in the I/F operating Instructions, to the settings obtained by reference to the calibration curves in the Handbook.

2. Set Control "S" to approximately zero dial reading.

3. Set the Power Amplifier Grid Current Control Switch to the "Raise" position.

4. Set the Phone-C.W.-M.C.W. Switch to "C.W."

5. Set the Tune Operate Switch to "Step 1".

6. Set the Remote-Local Switch to "Local".

7. Set Controls "A" and "W" to their "I/F" positions.

8. Start the Motor Generator by pressing the "Start" button and adjust Filament Voltage to 10 Volts by the Filament Voltage Rheostat.

9. Switch on Wavemeter G73, set the appropriate frequency by setting the Range Switch and Variable Condenser in accordance with the readings given by the Wavemeter Calibration Book (see note under). Set the change over switch to "C.W. Het. Det." Set the carrier level to 120 microamps on the meter.

Note:- Frequency to be set on Wavemeter. The I/F Master Oscillator always operates on one half the transmitter output frequency. The wavemeter is coupled to the Screen Grid of the Master Oscillator Valve, therefore, it follows that the Wavemeter must be set up to one half of the desired final frequency.

10. Press the Test Key and tune Control "O", I/F M.O. Tuning Inductance, until a "dead-space" is obtained in the headphones.

11. Place the Tune-Operate Switch in its "Step 2" position and adjust the Plate Voltage to 2000 volts by the Plate Voltage Rheostat.

12. Tune the I.F. Intermediate Amplifier Tuned Circuit, Control "Q" for maximum reading on the Power Amplifier Grid Current Meter (M9).

13. Tune the I/F Power Amplifier Tuned Circuit Control "R" for minimum reading in the Power Amplifier Plate Current Meter (M11).

14. Place the Tune Operate Switch in the "Operate" position.

15. Adjust I/F Antenna Inductance, Control "V" and I/F Antenna Tuning Variometer, Control "T" until maximum aerial current is obtained. When a large aerial is being used, and the transmitter is being tuned to a frequency near the 600 Kc/s end of the range, it may be necessary to bring the I/F Antenna Series Condenser into circuit by means of Control "U".

16. Gradually increase the I/F Antenna Coupling Control "S" until the Power Amplifier Plate Current Meter reads 350 milliamps.

17. Readjust Controls "T" and "S" for maximum Antenna Current with exactly 350 milliamps in the Power Amplifier Plate Current Meter.

Note:- After each and every aerial tuning adjustment, operation (13) should be repeated.

In order to be sure that the aerial circuit is tuned to the desired frequency and not to a harmonic, reference should be made to the tables of typical adjustments in the Handbook.

# TYPE TBL

TECHNICAL DESCRIPTION.

6. General.

The transmitter consists of two entirely separate radio frequency circuits to allow a frequency coverage of 175/600 kc/s and 2000/18,100 kc/s. The 175/600 kc/s band is known as the I/F and the 2000/18,100 kc/s the H/F band respectively.

These two R/F circuits use common valves for all stages except the Master Oscillator.

Only one of the two R/F circuits may be used at a time, and the selection of either circuit is accomplished by the operation of the Transfer Switch.

The H/F circuits of the transmitter consist of :-

MASTER OSCILLATOR. This consists of a Colpitts circuit connected as an electron coupled oscillator and covers a frequency range of 1000/2262·5 kc/s.

MASTER OSCILLATOR DOUBLING CIRCUIT forms part of the Master Oscillator Unit and is always in circuit for frequencies covered in the H/F band.

1st INTERMEDIATE AMPLIFIER is used as a fundamental or straight through amplifier for output frequencies of 2/4 Mc/s and as a frequency multiplier for output frequencies of 4/9 Mc/s. In the latter case this stage doubles the output frequency of the Master Oscillator unit, which is four times that of the MASTER OSCILLATOR.

2nd INTERMEDIATE AMPLIFIER is used as a straight through amplifier for output frequencies of 2000/9050 kc/s and as a frequency doubler for output frequencies of 9050/18,100 kc/s.

POWER AMPLIFIER operates as a fundamental or straight through amplifier over the entire frequency range of 2000/18,100 kc/s.

The I/F circuits of the transmitter consist of:-

MASTER OSCILLATOR using a standard Colpitts Oscillator circuit. The frequency range covered by this circuit is 87·5/300 kc/s which is just half the output frequency range of the I/F band.

INTERMEDIATE AMPLIFIER operates as a frequency doubling stage over the whole I/F range and has a frequency coverage of 175/600 kc/s.

POWER AMPLIFIER operates under all conditions as a straight amplifier.

M.C.W. OSCILLATOR uses a tuned grid, coupled anode circuit. The audio frequency modulation is performed on the screen grids of the POWER AMPLIFIER valves. M.C.W. can only be used on the I/F band as the valve used in the M.C.W. oscillator operates as the 1st Intermediate Amplifier valve when the transmitter is being used for H/F transmissions.

The identity letters and figures used throughout this description and on the figures are the same as those used in the Handbook, in a small number of instances additional identities have been inserted to enable closer reference to be made to figures and to simplify the explanation.

Transmitter T.B.L. consists essentially of the following basic units:-

(I) Transmitter Unit.

(II) Filter Unit.

(III) Magnetic Controller.

(IV) Motor Generator Unit.

In addition to the above items, the outfit is wired for connecting a Modulator Panel for R/T transmissions, but, as this is not fitted in H.M. Ships no further reference will be made to it.

The transmitter has been designed to cover the frequency ranges of 175 - 600 kc/s and 2 - 18·1 Mc/s designated I/F and H/F bands respectively. In order to keep the physical dimensions down as small as possible, dual use has been made of the valves, except for the respective Master Oscillators, and the change over from I/F to H/F in the main consists of merely changing the tuned circuits operating in conjunction with the valves in the various stages. This change-over is effected by the I/F - H/F transfer switch on the front panel. The operating voltages remain the same for both bands.

7. Valves Used and Their Functions.

| Valve | H/F | I/F (M.C.W.) | I/F (C.W.) |
|---|---|---|---|
| Type 860 | Master Osc. | - | - |
| " 860 | - | Master Osc. | Master Osc. |
| " 860 | 1st Int.Amp. | Audio Osc. | - |
| " 860 | 2nd Int.Amp. | 1st Int.Amp. | 1st Int.Amp. |
| 2 Type 803 in parallel. | P.A. | P.A. | P.A. |

8. Control and Oven Circuits. (Fig. B).

The 230 volts D.C. from the ships mains is fed direct to a D.P. switch (S311) fitted in the Magnetic Controller, this switch is normally secured in the "ON" position by a strip of insulating material which is clamped down by a screw. The switch is provided to isolate the complete installation for servicing purposes. The supply is then fed through two 10 amp. fuses, (F313, F314) from which point power is taken to operate all the relays in the starting and keying systems, to supply the Motor Generator and to actuate the temperature controlling elements in the Master Oscillator tuned circuits compartment.

9. Motor Generator Control Circuits.

On pressing the Start Button of the Start-Stop Switch (S26), the circuit is completed through the bobbin of the Starting Contactor (K4) and the Motor Solenoid Indicating Lamp 12 via the 15 amp. fuses in the transmitter unit (F3, F4) Emergency Switch (S24), transmitter door interlock switches (S28, S29, S30) Start-Stop Switch and the "P" contact of Remote-Local Switch (S25) (when in Local Position).

The Starting Contactor (K4) completes the supply to the Field Contactor (K3) and the Plate Voltage Indicating Lamp 13, via contacts "E" and "F" of the transmitter Overload Relays (K8 and K10) and, at the same time, the main coil (K312M) of the Accelerating Contactor is energised through the Filter Unit door Interlock switch (S150), contact "G" of the Thermal Controlled D.C. Supply Overload Contactor (K313) and contact "A" of the Line Contactor (K311).

The Field Contactor (K3) has two contacts, "H" completes the 250 volts output from the Grid Bias Generator to the shunt Field Winding of the High Voltage Generator through its associated Field Regulator resistance (R41), contact "I" completes the circuit through the Grid Bias Generator Field Coil, from the Generator's 250 volt output, via the Grid Bias Generator Field Regulator resistance (R150). (See Fig. "C").

The Accelerating Contactor operates as soon as the circuit through its main coil (K312M) is completed, it has three contacts, "K" removes the short-circuit from the Starting Resistance (R311, R314, R315) inserting them in series with the Motor Armature circuit, contact "L" completes the supply to the Neutralising Coil (K312N) of the Accelerating Contactor (via Timing Resistance (R313) and to the bobbin (K311) of the Line Contactor, the third contact "J" functions in the Keying Circuit as described in Section 10.

On operation of the Line Contactor, (K311) the D.C. supply to the Motor Generator is completed through contacts "C" and "D", contact arm "A" moves to the "B" position breaking the supply to the Main Coil (K312N) of the Accelerating Contactor and completing a "hold-on" circuit for the Line Contactor through economy resistance R312. The Accelerating Contactor is still held in the "ON" position by the high retentivity of its core.

After a certain definite period of time, determined by the current through the Neutralising Coil (K312N), the Accelerating Contactor will throw off and contact "K" will short circuit the Starting Resistances (R311, R314, R315), thus placing the Motor Generator in its normal running condition.

The core of the Accelerating Contactor is made of metal with high renentivity and, after the current through the Main Coil (K312M) ceases, the core is sufficiently magnetised to hold the contact down; this residual magnetism is neutralised by the current flowing through the Neutralising Coil (K312N) which is wound in the opposite direction to the Main Coil. When operating the set from a remote position, the Remote-Local Switch (S25) is placed to "Remote" and the starting circuits function as described above when the Control Switch in the remote position is made, the circuit for the Starting Contactor (K4) now being completed via "M" and "O" contacts of the Remote-Local Switch (S25). It should be noted that the Start button of the Start-Stop Switch (S26) on the transmitter must be depressed before the control circuits will function.

On pressing the "Stop" Button of the Start-Stop Switch (S26), the circuit through the Starting Contactor (K4) is broken and hence the circuit to the bobbin of the Line Contactor (K311), contacts "C" and "D" then break the supply to the Motor Generator.

The Motor Generator will also stop if the Emergency Stop Switch (S24) is broken, if the Overload Relay Bobbins K8 or K10, in the 1000 volts and 2000 volts negative return leads operate by excessive currents flowing through them due to overloading of valves, or if the supply voltage drops by 10%. In the latter case the Starting Contactor (K4) will throw off, but, as the circuit through its bobbin is still complete, it will operate again, restarting the Motor Generator as soon as the supply voltage rises above the 10% reduction.

If the Overload Relay Bobbins K8 and/or K10 operate, contacts "E" and "F" will be pulled to their off position against the tension of a spring, tension being so adjusted that the contacts will break on a predetermined current flowing through the bobbins. When broken the contacts are held in this position by a mechanical interlock with the contacts of the Overload Relay reset coils (K8A, K8B). On pressing the overload Relay Reset Switch (S35), a circuit is completed through the reset coils (K8A, K8B), their contacts move toward their cores, disengaging the mechanical interlock between "E" and "F" contacts, these latter contacts then revert to their made position due to the action of the springs.

10. D.C. Keying Circuit. The necessary voltage required to operate the Keying Relay (K6) is obtained from the potential drop developed across resistance R39, which forms part of the Keying Potentiometer (R38, R39) connected across the D.C. supply. Reference to Figure B shows that the positive return is completed through one contact ("J") of the Accelerating Contactor and contact "C" of the Line Contactor. Referring back to the action of these contactors, in the preceding section, it will be seen that the circuit through the Keying Potentiometer will not be complete until the cycle of operation of these contactors, consequent on pressing the Start button of the Start-Stop switch (S26) has been completed; this is to prevent the transmitter from being keyed during the small period of time when the Motor Generator is running up to its operating speed and the valve filaments are heating up to their correct operating temperatures.

In series with the Keying Relay (K6) are the Keying Resistance (R38) and the auxiliary contacts on seven switches in the transmitter. The auxiliary contacts and the switches concerned are - S15A, H/F - I/F, Transfer Switch, S16A H/F Range Switch, S18A Antenna Transfer Switch, S19A I/F Antenna Inductance Switch, S20A I/F Range Switch, S22A Tune-Operate and S34A I/F Antenna Series Capacitor Switch; it will be noticed that there is one auxiliary contact on every switch that has power applied to it when the key is pressed, thus damage to components due to arcing between contacts of switches consequent to their being moved with power on, is eliminated by the action of their own auxiliary contacts.

When the Remote-Local Switch (S25) is to Local the Keying Relay (K6) can only be energised through the Test Key (S27), on changing to the Remote position the Test Key will still cause the Keying Relay to function and, in addition, it can be operated by the Morse Key in the remote position provided the Phone-M.C.W.-C.W. Switch (S7) is in either the M.C.W. or C.W. positions.

11. Oven Circuits.

The frequency determining components of H/F and I/F Master Oscillator circuits are contained in a compartment maintained at a working temperature of 60°C. by the action of the Mercury Thermostat (S3) in conjunction with the Heater Resistance (R4) and Blower (B1).

The Mercury Thermostat (S3) completes the circuit from positive through the bobbin of the Thermostat Relay (K1) back to a tap on the Thermostat Relay Potentiometer (R2) when the temperature of the oven is below 60°C, and, breaks this circuit when the temperature rises above this level.

The moving contact of the Thermostat Relay (K1) completes a circuit from positive supply through the Heater Resistance (R4) with Heater Power Lamp (T1) and associated resistance, in parallel. Bi-Metallic Thermal Switch (S2) opens, to break the heater circuit, when the temperature of the oven rises above 70°C, and, will close again when the temperature falls to approximately 57°C: operation of this switch will only be brought about by abnormal external temperature conditions. The Line Voltage Switch (S36) is used to bring resistances R152 and R151 in series with the Heater Circuit, to protect the components of the circuit from overload when the supply voltage, as shown by Voltmeter (M4), rises above normal.

Bi-Metallic Thermal Switch (S31) is used to bring into circuit an additional Heating Resistance (R40) to accelerate the oven reaching its operating temperature when being started from cold, this switch closes at approximately 43°C and opens when the temperature reaches approximately 55°C.

The Heater Resistances (R4, R40) are situated in a compartment adjacent to the main temperature controlled compartment and are directly in the path of an air stream which being constantly circulated through the oven by the action of the Blower Motor (B1), the air stream follows a closed path from Blower, across Heating Resistances, through temperature controlled compartment and back to Blower.

It should be observed that the mains supply to the Blower and components of the heating circuit is independent of the other control circuits, and, under normal conditions, will always be made.

Operation of the Emergency Stop Switch (S24) will break these circuits, therefore, if it has been found necessary to use this switch, care should be taken to allow sufficient time for the oven to regain its correct temperature after switch has been remade.

Starting from "cold", it will normally take approximately three hours for the temperature of the oven to reach a stable operating point of 60°C.

POWER SUPPLIES.

12. Motor Generator and Filter Units (Fig. "C").

The 230 volt D.C. Motor is compound wound, and is fitted with a speed regulator, to hold the speed substantially constant at 1780 r.p.m., for variations in supply voltage between the limits of approximately 330 volts and 155 volts, and, for normal temperature and load variations.

# TYPE TBL

RW31

## CONTROL AND OVEN CIRCUITS

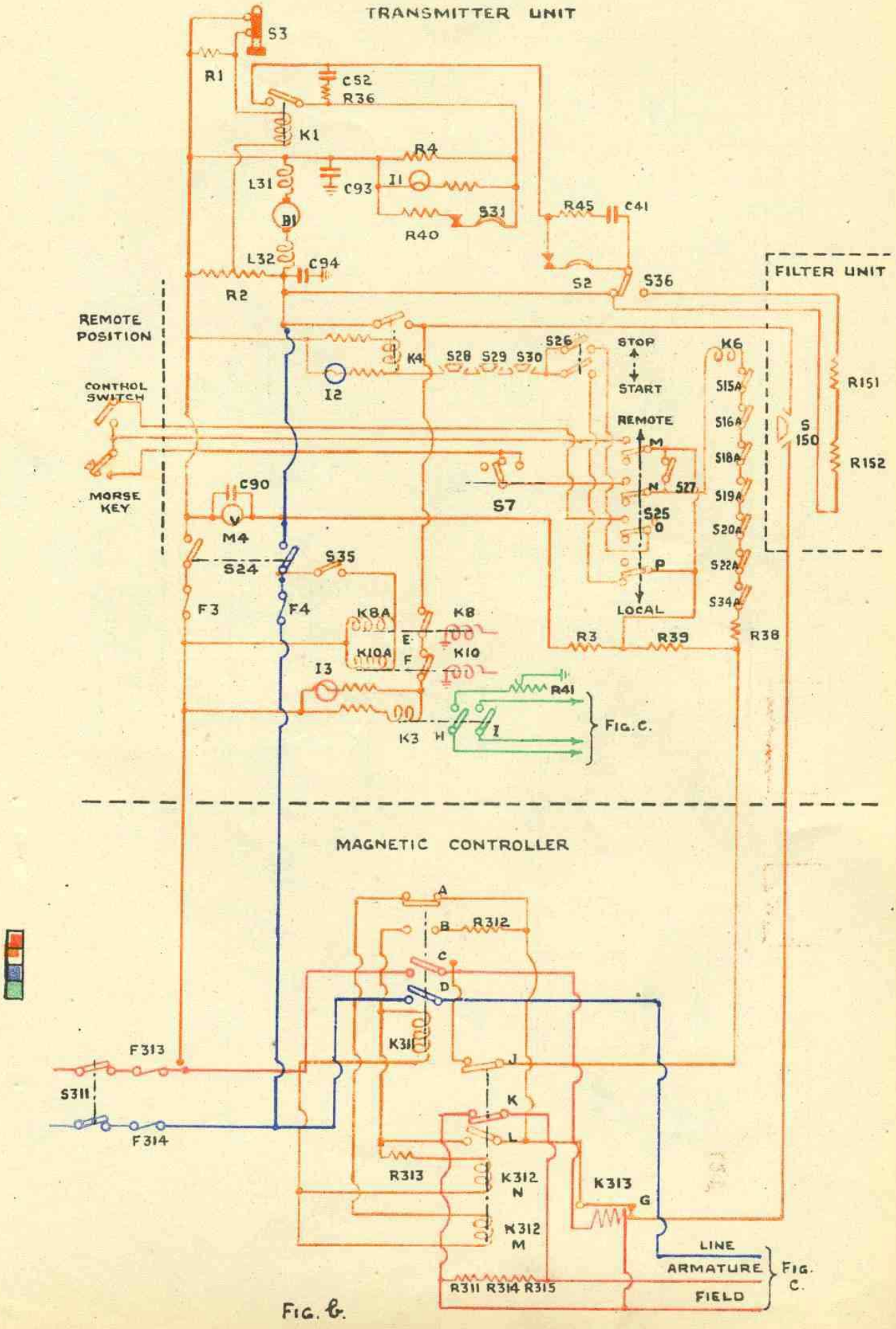
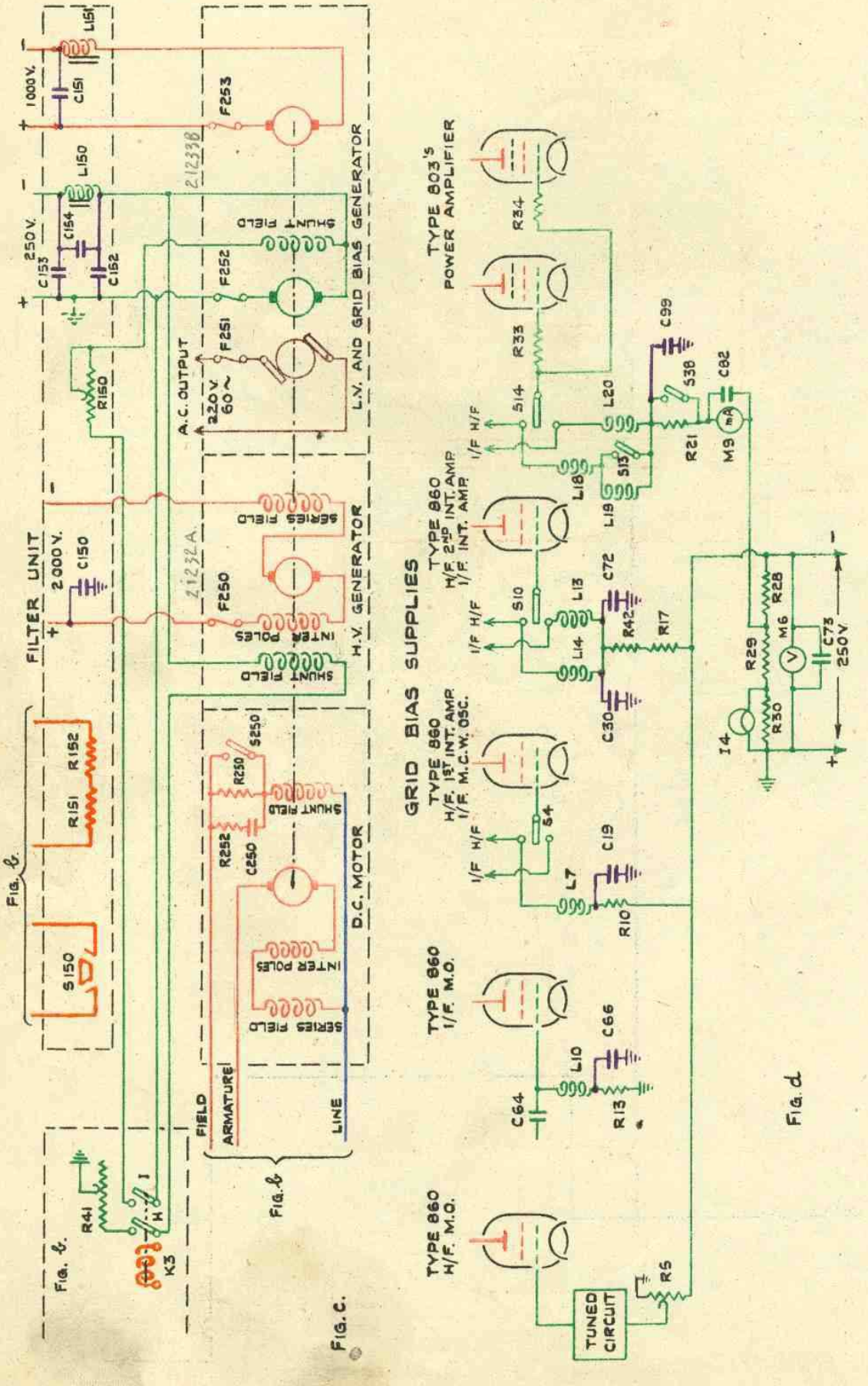



FIG. 6.

RW32

# TYPE TBL

## MOTOR GENERATOR AND FILTER UNITS



The speed regulator consists of a single contact vibrating regulator (S250), the movement of which is controlled by the output from two slip-rings on the main shaft (not shown in sketch).

The vibrating contact is connected across resistance (R250) which is in series with the shunt field of the motor.

Coupled to the shaft of the Motor are the High Voltage and Low Voltage and Grid Bias Generators.

High Voltage Generator.

A compound wound machine. The Shunt Field Coil is excited from the 250 volt D.C. Generator that forms a part of the Low Voltage and Grid Bias Generator. The Series Field and Inter-Pole coils are connected in series with the 2000 V armature.

Generator has been designed to give an output of 2000 v; this can be varied as requisite to obtain required power output from the transmitter, by adjustment of the Plate Voltage Rheostat (R41) situated in the transmitter unit and controlled from the front panel (Fig. "A"). The voltage fed to the transmitter is smoothed by a condenser (C150) fitted in the Filter Unit.

Low Voltage and Grid Bias Generator.

This is a shunt wound generator with three outputs:

(i) 1000 volts D.C.
(ii) 250 volts D.C.
(iii) 220 volts 60 cycle A.C.

The shunt field is excited from the 250 volt winding. Adjustment of the output voltage is obtained by means of a variable resistance (R150) connected in series with the shunt field, this resistance is fitted in the Filter Unit.

Choke (L150) and condensers (C152, C153, C154) in the Filter Unit, smooth the 250 volt supply to the transmitter, choke (L151) and condenser (C151) perform the same function for the 1000 volt output.

13. Grid Bias Supplies (Fig. D).

The 250 volt D.C. output from the Grid Bias Generator is connected across the grid bias potentiometer (R28, R29, R30) where the positive is earthed, in order to obtain the necessary negative potentials for application to the grids of the respective valves.

Voltmeter (M6) is connected across the potentiometer to indicate the voltage output from the Grid Bias Generator.

Indicating lamp (D4), with a green shade, is connected across a portion of the potentiometer (R30). The lamp will light when an output is being obtained from the generator.

Operating Grid Bias Voltage Supplied to Valves.

H/F M.O. 27 volts ~~obtained~~ SELECTED BY SEMI-ADJUSTABLE POTENTIOMETER R5. from 250 volts dropped by semi-adjustable resistance R5.

I/F M.O. Small operating potential obtained by grid current flowing; time constant of grid condenser (C64) and grid leak resistance (R13) determines its value.

H/F 1st Intermediate Amplifier. 250 volts via grid resistances (R10) and grid R/F choke (L7). Grid resistance is to provide additional bias, under operating conditions, due to grid current flowing.

I/F M.C.W. Oscillator. Small operating potential provided by Grid Leak (R11) and Grid Condenser (C21) combination (Fig. G) consequent of grid current flowing.

H/F 2nd Intermediate Amplifier. 250 volts via resistance (R17, R42) and R/F Choke (L14). Resistances are to provide additional operating bias due to flow of grid current.

I/F Intermediate Amplifier. As for H/F 2nd Intermediate Amplifier, except through R/F Choke (L13) instead of (L14).

H/F Power Amplifier. 135 volts from the junction of resistances R28 and R29, forming part of the Grid Bias Potentiometer, via P.A. Grid Current Meter (M9), Grid Resistance (R21) and Grid R/F Choke Coils (L19, L18). Grid Resistance (R21) is for providing additional operating bias due to grid current flowing and is only brought into circuit by the P.A. Grid Current Control Switch (S38) when the reading in the P.A. Grid Current Meter (M9) exceeds 90 milliamps. R/F Grid Choke Coil (L19) is brought into circuit by one contact (S13) of the H.F. Range Switch (Control "H") when in the 2 -4·1 Mc/s. position, to give effective R/F impedance when working on this range.

I/F Power Amplifier. 135 volts as for H.F. Power Amplifier, except that R/F Grid Chokes (L18, L19) are replaced by one R/F Grid Choke Coil (L20).

The transfer from H/F to I/F conditions, as far as the grid circuits are concerned, is effected by switches S4, S10 and S14 which are operated by the I/F - H/F Transfer Switch (Control "A").

# TYPE TBL

## H.T. AND FILAMENT SUPPLIES

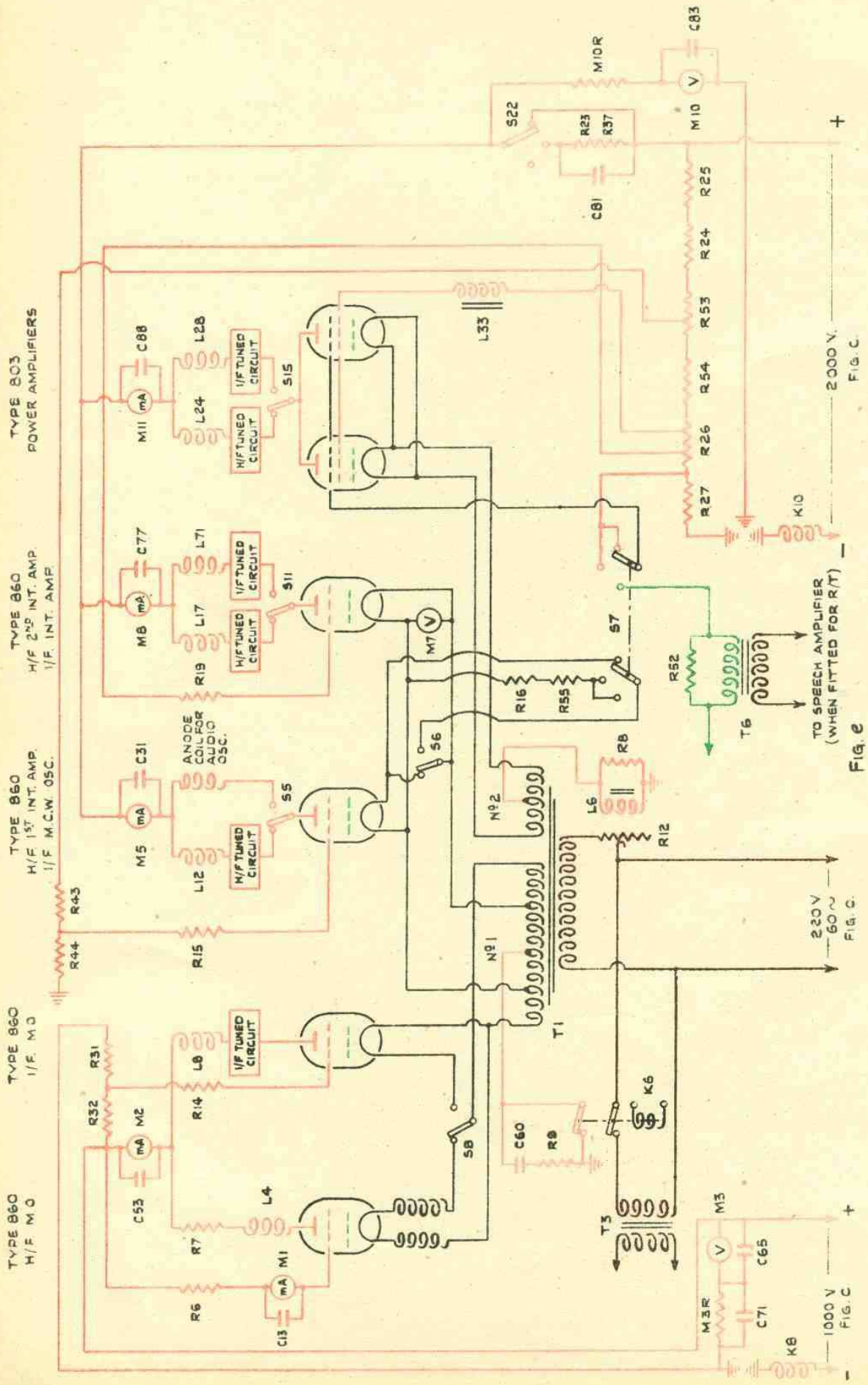



Fig. e

14. Filament Supplies (Fig "E").

The 220 volt 60 cycle output from the Low Voltage Generator is applied to the primary of the Filament Transformer (T1) via the Filament Voltage Rheostat (R12), this should be adjusted to give a reading of 10 volts, in the Filament Voltmeter (M7), connected across the supply to the intermediate amplifying valves.

A parallel feed is taken from the 220 volts 60 cycle supply, via one contact of the Keying Relay (K6), to energise the primary winding of a transformer (T3), used to actuate the Compensating Condenser (C7) forming part of the H/F M.O. tuned circuit.

The Filament Transformer (T1) has two secondary windings, Number one winding supplies the filament of either the H/F Master Oscillator Valve, or the I/F Master Oscillator Valve the change over being effected by a switch (S8) which is operated by the I/F-H/F Transfer Switch (Control "A"). A tapping on No. 1 winding supplies the filament of the Type 860 valve, that functions as the H/F 2nd Intermediate Amplifier or I/F Intermediate Amplifier, direct and via switch (S6), operated by I/F - H/F Transfer Switch (Control "A"), to the filament of the Type 860 valve that functions as the H/F 1st Intermediate Amplifier, or, as a M.C.W. oscillator for I/F working. When the I/F-H/F Transfer Switch is to I/F the filament circuit of this valve is completed only when the Phone-C.W.-M.C.W. Switch is in its "M.C.W." position, when to the "Phone" or "C.W." positions, filament circuit is broken, and compensating resistances (R16, R55) are brought into circuit, thus a constant load is maintained on the Filament Transformer irrespective of the mode of transmission being used.

No. 2 winding of the Filament Transformer supplies direct the filaments of the two Type 803 Power Amplifier valves connected in parallel.

15. Anode and Screen Grid Supplies (Fig. "E").

The 100 volt D.C. output from the Low Voltage Generator is effectively applied across a potentiometer (R31, R32), the negative lead passing through one bobbin (K8) of the Overload Relay. Voltmeter (M3), with its associated series resistance (M3R), is connected across the potentiometer to show the voltage output from the generator.

The high potential end of the potentiometer is taken, via the Master Oscillator Anode Milliammeter (M2), to the anode of the H.F. Master Oscillator valve through a dropping resistance (R7) and the H/F R/F Anode Choke Coil (L4). The anode potential for the I/F Master Oscillator valve is taken from the Milli-ammeter (M2) and fed through the I/F R/F Anode Choke Coil (L8) and tuning inductance forming part of the I/F Anode Tuned Circuit.

The operating voltages applied to the H/F and I/F Master Oscillator valve Anodes are 700 volts and 950 volts respectively.

The Screen Grid potential for both valves is 300 volts, for the H/F Master Oscillator is is obtained from the 1000 volt end of the potentiometer and fed through a dropping resistance (R6) and the H/F Screen Grid Current Milliammeter (M1), the I/F Master Oscillator obtaines its screen potential from the junction of the two resistances(R31, R32), forming the potentiometer, which is fed to the screen grid via a dropping resistance (R14).

The 2000 volt D.C. output from the High Voltage Generator is applied across the high voltage potentiometer (R27, R26, R54, R53, R25, R24), the negative supply passing through one bobbin (K10) of the Overload Relay. The high potential end of the potentiometer is connected through the Tune-Operate Switch (S22) to the anodes of the Intermediate and Power Amplifying valves through their respective anode milliammeters, (M5, M8, M11), Anode R/F Choke Coils (H/F - L12, L17, L24, I/F-M.C.W Oscillator Anode Coil, L71, L28) and the Tuning Inductances of the particular circuit in use, depending on the position of the H/F - I/F Transfer Switch (Control "A") which operates switches S5, S11 and S15.

The Tune-Operate Switch (S22) has three positions:
"Step 1" for breaking all H.T. supplies with the exception of those to the Master Oscillator Valve, used for tuning the Master Oscillator circuits.

"Step 2" inserts two resistances (R23, R37) in series with the 2000 volt supply to the anodes of the Intermediate and Power Amplifiers to reduce their voltages when tuning.

"Operate". Normal operating position, full voltages applied to all stages.

Voltmeter (M10), with its series resistance M10R, is connected between the output of the Tune-Operate Switch (S22) and the 2000 volt negative.

Screen Grid potentials for the Intermediate and Power Amplifier valves are obtained from appropriate taps on the 2000 volt potentiometer and fed via their appropriate dropping resistances.

16. R/F Keying Circuit. (Fig. "E").

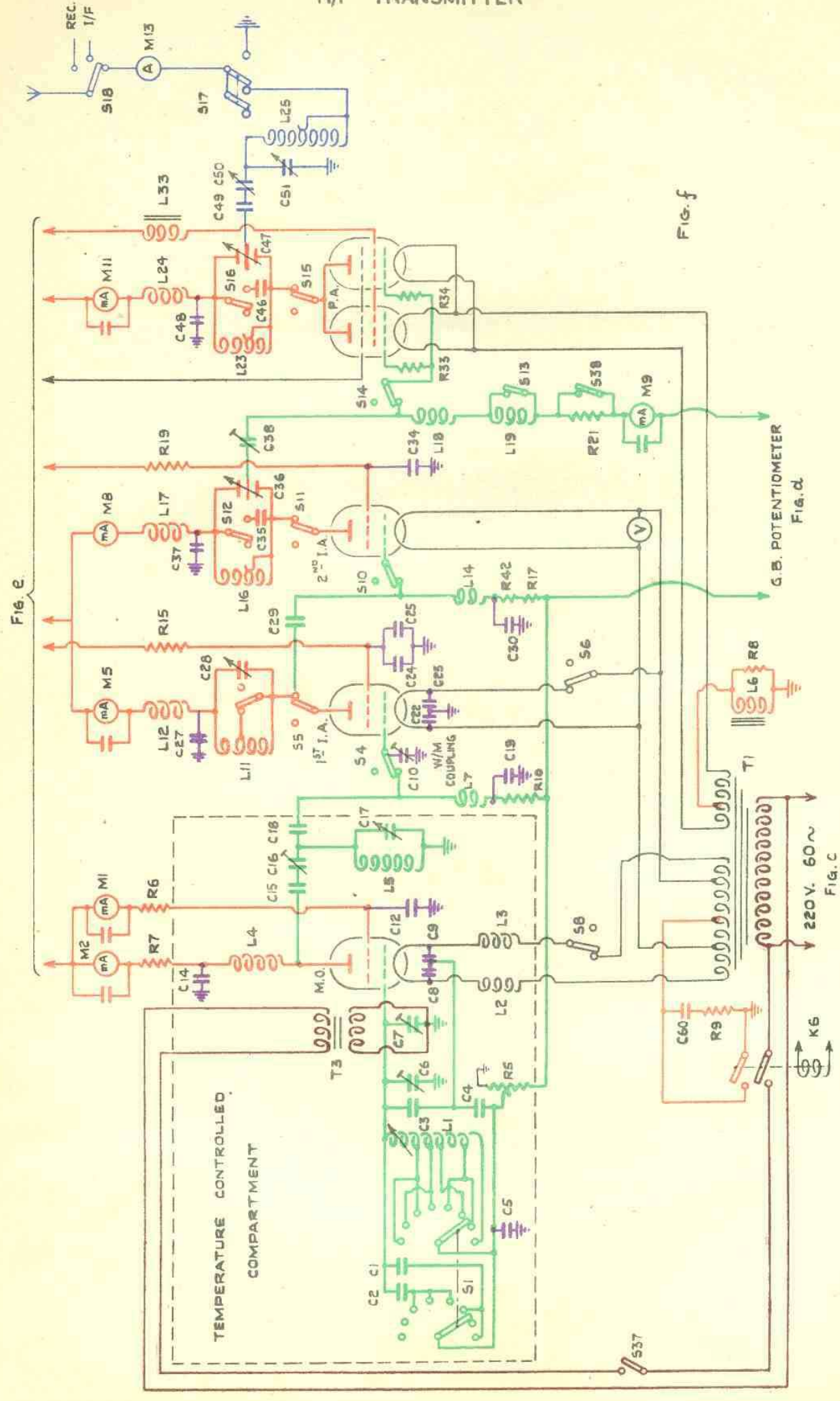
One contact of the Keying Relay (K6) completes the negative H.T. return to earth, from the centre of the Filament Transformer No. 1 secondary winding, of all the valves, except the Power Amplifier valves, regardless of whether the valves are operating in the H/F or I/F transmitting circuits.

The Power Amplifier valves are supplied with sufficient grid bias so that when grid excitation from the preceding stages is removed, that is with the Keying Relay at rest, they automatically close down.

RW36

# TYPE TBL

## H/F TRANSMITTER



17. H/F Transmitter (Fig. F).

The H/F Master Oscillator employs a Type 680 valve in an electron coupled circuit. The screen grid of the valve is functioning as the anode as far as the tuned circuit is concerned; it is at earth potential from a R/F view point (C12) and is connected to the low potential end of the tuned circuit by R/F bypass condenser (C5), thus the valve can be regarded as a normal Colpitts Oscillator, but, as the virtual anode of the Oscillator is the screen of the valve, it follows that the current passing across the valve to the true anode will be modulated by the R/F potential variations present on the screen.

The Tuned Circuit has been designed to cover a frequency range of 1000 - 2262•5 Kc/s in eight bands dependent on the position of the H/F M.O. Band Switch (S1). This switch has eight positions and arranges the necessary combination of tappings, on the rough tuning portion, of inductance L1 in conjunction with the fixed condensers C1 and C2. Fixed condensers C3 and C4 provide the main tuning capacity. Fine tuning is effected by moving a copper cylinder laterally through the tuning coil. The eddy currents set up in the cylinder tend to neutralise the currents in the coil with resulting reduction in inductance. The movement of the copper cylinder is controlled by a worm screw drive which is brought through to a control on the front panel, the dial geared to this control has 5000 numbered graduations each of which is further sub-divided by a half thus, in combination with the eight positions of the Band Switch (S1), 80,000 clearly defined different adjustments can be made to this circuit, this is extremely useful in resetting a frequency from a calibration card for, the frequency difference between adjacent minimum tuning settings is 16 cycles, and even, allowing for the doubler stages later in the circuit, this allows for a high degree of accuracy in applying adjustments.

All frequency determining components of the Master Oscillator circuit are contained in the thermo-statically controlled oven. Condenser (C7), a bi-metallic type is connected between grid and earth, one plate is in series with the secondary of Transformer T3, the primary of which is connected to the A.C. supply, through one contact of the signalling relay (K6), thus, when the operating key is pressed the physical dimensions of one plate of Condenser C7 will expand due to the heating effect of the current flowing through it, and, the resultant effect on its capacity is designed to neutralise any variation of the Master Oscillator valve inter-electrode capacity, due to heating during operating conditions. Condenser C7 is adjusted at the Factory and should not be altered.

Preset Condenser (C6), also adjusted in the Factory, is used to adjust the M.O. tuned circuit to allow for small changes in dial calibration due to ageing of parts or changes in the characteristics of the M.O. valve.

Radio frequency chokes (L2, L3) in each filament lead prevents the high R/F potential on the filament from leaking to earth through the secondary of the filament transformer (T1). R/F bypass condensers (C8, C9) provide a centre tap on the filament for connecting to the mid point of the main tuning condensers (C3, C4).

Approximately 700 volts are required on the anode of the valve, this is obtained from the low voltage generator via anode current meter (M2), dropping resistance (R7) and anode choke coil (L4). The latter is to prevent R/F power from leaking to earth through the low voltage generator.

The Screen Grid Potential, also obtained from the low voltage generator, is dropped to approximately 300 volts, by resistance (R6), Milliammeter (M1) will read the screen current.

Approximately 27 volts negative is applied to the grid, this is provided by the 250 volt grid bias generator dropped ~~by the semi-adjustable resistance R5,~~ AND IS SELECTED BY THE SEMI-ADJUSTABLE RESISTANCE R5

The values of anode and screen grid potential are the optimum voltages for maximum frequency stability when using a Type 860 valve as an electron coupled Oscillator. It has been found experimentally that, with a steady potential on the screen, frequency will vary inversely to voltage variations on the anode conversely, with a steady potential on the anode, frequency variations appear directly effected by voltage variations on the screen. It can be seen that with correct balance between normal operating voltages and dropping resistances, it can be arranged that curves indicating resultant frequency variations, due to potential fluctuations on anode and screen, shall be equal and opposite, thus, in this manner the transmitter can be made stable against normal variations in supply voltage. Filament heating current is obtained from No. 1 winding of the filament transformer (T3).

18. H/F First Intermediate Amplifier.

The Master Oscillator is coupled to the first intermediate amplifier doubler circuit by a small preset condenser (C16). A larger fixed condenser (C15) is connected in series to prevent possible damage to the doubler circuit by D.C. if damage occurs to the coupling condenser. The doubler circuit, consisting of fixed inductance (L5) and variable condenser (C17) is always tuned to the second harmonic of the Master Oscillator i.e. 2000 - 4525 Kc/s and is effectively connected between grid and filament of the first intermediate amplifier by the fixed condenser (C18) and R/F bypass condensers (C22, C23) respectively. The connection to the grid is via one contact (S4) of the I/F - H/F transfer switch on the front panel of the set.

Another Type 860 valve is employed in this stage, and, when the I/F - H/F transfer switch is in its H/F position, contact S5 connects the valve to a tuned anode circuit, consisting of fixed inductance L11 and variable condenser C28. For transmitted frequencies of 2000 - 4000 Kc/s, this stage acts as a "Straight through" Amplifier, but, for transmitted frequencies of between 4000 and 9050 Kc/s, switch S9 short-circuits a portion of the tuning inductance L11 and the stage then functions as a frequency doubler, that is at the fourth harmonic of the Master Oscillator.

The anode potential of 2000 volts is obtained from a high voltage generator via the tune-operate switch (S22), anode ammeter (M5) and radio frequency choke coil (L12), the latter is to prevent R/F power leaking to earth through the high voltage generator or high voltage potentiometer (R27, R26, R54, R53, R25, R24). Screen grid potential of approximately 490 volts is obtained from the junction of potentiometer resistances R43 and R44 which are in turn connected across resistances R26, R27, R54 and a portion of R53 which form part of the high voltage potentiometer.

250 volts negative bias is obtained from the grid bias generator via resistance R10 and R/F grid choke coil L7, the latter presents a high impedance path for the R/F grid voltage to earth, R/F bypass condenser C19 protects the grid bias potentiometer and generator from any R/F currents that may pass through the grid choke coil L7. Resistance R10 provides additional bias under operating conditions due to grid current flowing. Filament heating current is obtained from No. 1 winding of the filament transformer (T3) via one contact of the Phone - M.C.W. - C.W. change-over switch (S7).

19. Second Intermediate Amplifier.

The radio frequency output of the First Intermediate Amplifier is capacity coupled to the grid of the Second Intermediate Amplifier by fixed condenser C29 and one contact (S10) of the I/F - H/F Transfer Switch. This stage employs another Type 860 valve with a tuned anode circuit, the connection to which is effected by contact S11 of the I/F - H/F Transfer Switch. The tuned circuit consists of a variable inductance (L16) and a split stator variable condenser C36, the tuning of these two components is ganged to maintain a constant L.C. ratio throughout the whole frequency range.

This stage functions as a "straight through" Amplifier for transmitted frequencies of 2000 - 9050 Kc/s. but, for transmitted frequencies in the 9050 - 18,100 Kc/s band, the stage functions as a doubler by the removal of a fixed condenser (C35), in parallel with the variable tuning condenser, by one contact (S12) of the H/F Range Switch.

Anode potential of 2000 volts is obtained from the High Voltage Generator via the Tune-Operate Switch (S22), Anode Ammeter (M8) and Radio Frequency Choke Coil (L17).

Screen grid potential of approximately 320 volts is obtained from a tapping on resistance R26 forming part of the high voltage potentiometer and fed via dropping resistance R19.

Grid bias of 250 volts negative is provided by the Grid Bias Generator via resistances R17 and R42 and R/F Grid Choke Coil (L14).

Filament heating current is obtained from No. 1 secondary winding of the Filament Transformer.

20. Power Amplifier.

This stage employs 2 Type 803 pentode valves connected in parallel and functions as a "straight through" Amplifier over the whole frequency range of the transmitter.

The R/F Output from the Second Intermediate Amplifier is taken from the rotor plate of the variable condenser and is capacity coupled to the two grids of the power amplifier valves via preset condenser C38, one contact of I/F - H/F Transfer Switch (S14) and Anti-parasitic Resistances (R33, R34). The tuned anode circuit, connected to the valve by contact S15 of the I/F - H/F Transfer Switch, is similar to that employed by the second Intermediate Amplifier and consists of variable tuning inductance (L23) and split-stator tuning condenser (C47), their tuning being ganged, and, fixed Condenser C46 which is brought into circuit in parallel with the main tuning condenser (C47) for frequencies between 2000 and 4000 Kc/s.

Normal anode potential of 2000 volts is supplied by the High Voltage Generator Via the Tune-Operate Switch (S22). Anode Ammeter (M11) and R/F Choke Coil (L24).

The suppressor grids are fed with a small positive potential from a tapping on the high voltage potentiometer, via one contact of the Phone-M.C.W.-C.W. change-over switch (S7).

Screen grid potential, approximately 300 volts, is obtained from a further tap on the high voltage potentiometer and is fed via A/F Choke Coil L33, the latter being inserted to prevent the A/F voltage variations from leaking to earth through the 2000 volt potentiometer when M.C.W. is being used.

Grid bias of approximately 135 volts negative is obtained from the grid bias potentiometer via R/F grid choke coils L18 and L19. L19 is short-circuited by switch S13 when the H/F Range Switch is in its 9050 - 18,100 Kc/s position.

21. Aerial Circuit.

The aerial circuit is capacity coupled to the Power Amplifier by a variable condenser (C50), a larger fixed condenser (C49) is connected in series to protect the aerial circuits from D.C. potentials, that might arise if damage or voltage break down occurred to the coupling condenser (C50).

The aerial is tuned by the variable tuning inductance (L25) and variable tuning condenser (C51), these two components may be connected in series or parallel by switch S17 which is marked "Current and Voltage Feed". The top of the tuned circuit is connected to the aerial via the Aerial Ammeter (M13) and one contact of the Aerial Transfer Switch (S18).

I/F TRANSMITTER (FIG. G).

22. Master Oscillator.

The Master Oscillator uses a Type 860 valve connected in a standard Colpitts Oscillator circuit.

The frequency determining parts of the circuit are located in the thermostatically controlled oven.

The circuit covers a frequency range of 87.5 - 300 Kc/s, this is half the transmitted frequency range of the set, and, is used to cut down to a minimum the effect of the succeeding circuits on the Master Oscillator circuit. Tuning is covered in seven bands arranged by the seven positions of the Range Switch (S23), this switch selects the appropriate tapping on inductance L30 in combination with a suitable arrangement of the fixed condensers (C55, C56, C57, C58). Fine tuning is achieved by adjustment of the Variometer (L9).

The Variometer (L9) has 2,500 clearly defined graduations, these, in conjunction with the seven positions of the Range Switch, give 17,500 different calibrated points to cover the frequency band, that is approximately 12 cycles between adjacent graduations, this enables a high degree of accuracy to be achieved in resetting a frequency from a Calibration Book.

Fixed Condenser C64 is to prevent the D.C. Anode potential from feeding on to the grid of the valve, Fixed Condensers C61, C62 and C63 form the main tuning capacity and are proportioned across the circuit to provide the proper grid filament R/F voltage and coupling to the succeeding stage over the whole frequency range. The junction of C61 and C62 is directly earthed and is connected to the filament via the filament bypass condensers C67 and C68.

Anode potential of approximately 950 volts is obtained from the Low Voltage Generator via Anode Ammeter (M2) and R/F Choke Coil (L8).

Approximately 300 volts are applied to the screen grid, from the junction of resistances R31 and R32, which are connected across the output of the Low Voltage Generator. Resistance R14 is connected in this circuit to prevent excessive screen grid current. L10 is the R/F grid choke coil to prevent R/F potentials leaking to earth, C66 is to by-pass resistance R13 for any R/F currents that may leak through the R/F grid choke coil.

23. Intermediate Amplifier.

Coupling to the grid of the intermediate amplifier is obtained from the junction of condensers C62 and C63 in the Master Oscillator tuned circuit via the I/F - H/F Transfer Switch (S10). This stage, employing a Type 860 valve has a tuned anode circuit connected by contact S11 of the I/F - H/F Transfer Switch, and covers a frequency range of 175 - 600 Kc/s, in five bands. Selection of the requisite band is performed by switch S21, this arranges the correct combination of the fixed condensers (C74, C75) in conjunction with the appropriate tap on the tuning inductance (L15), fine tuning is achieved by adjustment of the variometer portion of the tuning inductance.

Anode potential of 2000 volts is obtained from the High Voltage Generator via the Tune-Operate Switch (S22), Anode Ammeter (M8) and R/F Choke Coil (L71).

Screen grid is applied with approximately 320 volts from a tapping on the high voltage potentiometer via resistance R19.

Grid bias of 250 volts negative is taken from the grid bias generator via resistances R17 and R42 and R/F grid choke coil L13.

24. Power Amplifier.

Correct R/F potential is fed to the grids of the two Type 803 Pentode Valves connected in parallel from the junction of fixed condensers C79 and C80 which are connected across the tuned anode circuit of the Intermediate Amplifier. The connection to the grids is via contact S14 of the I/F - H/F Transfer Switch and antiparasitic resistances R33 and R34.

The Power Amplifier has a tuned anode circuit covering the whole frequency range in five bands, the requisite band is selected by the Range Switch (S20) which is ganged to the Intermediate Amplifier Range Switch (S21). The Range Switch (S20) arranges the correct combination of fixed condensers (C84, C85) in conjunction with fixed condenser C86 and taps on the rough tuning portion of inductance L22. The Range Switch also selects the correct amount of inductance in coil L29A for coupling to the Aerial Circuit. Fine tuning is effected by the adjustment of the Variometer portion of the tuning inductance (L22).

25. Aerial Circuit.

The aerial is mutually coupled to the Power Amplifier tuned circuit by coils L29 and L29A, the degree of coupling being variable by Control S.

The aerial circuit is tuned by two fixed condensers connected in parallel (C91, C95), tapped inductance L26 and Variometer L27. The tapped inductance has 15 taps adjusted as necessary by a switch (S19).

# TYPE T B L

A fixed condenser (C92) can be joined in series with the I/F tuned aerial circuit by a switch (S19) and is used when operating on, or near, the high frequency end of the I/F band, on an unusually high capacity aerial. An Ammeter (M12) is connected in the aerial circuit to indicate aerial current.

19. M.C.W. Oscillator.

When the H/F - I/F Transfer Switch (Control "A") is to "I/F" and the Phone - C.W.- M.C.W. Switch (S7) is in its "M.C.W." position, the Type 860 valve used as the H/F. 1st Intermediate Amplifier now functions as an Audio Oscillator at a frequency of approximately 800 c/s. The stage is connected as a conventional "tuned grid, coupled anode" oscillator.

An iron cored A/F Transformer (T4) has one winding connected between grid and filament, this winding is tuned by a fixed condenser (C20) to the audio frequency.

Grid condenser (C21) and grid leak resistance (R11) are for providing the necessary operating bias on the grid.

The other winding of the A/F transformer (T4) is connected in series with the H.T. Supply to the anode of the valve, thus providing sufficient feed-back, of audio frequency oscillations, to the tuned grid circuit, to maintain it in an oscillatory condition.

In order to modulate the R/F output of the transmitter, a coupling is taken from a tap on the anode coil of the M.C.W. oscillator and fed via the A/F coupling condenser (C26) to the screen grids of the Power Amplifier valves. Choke (L33) in the potential supply lead to these screen grids is to prevent the A/F voltage variations from leaking to earth through the 2000 volt potentiometer.

# TYPE TBL

RW41

## I/F TRANSMITTER

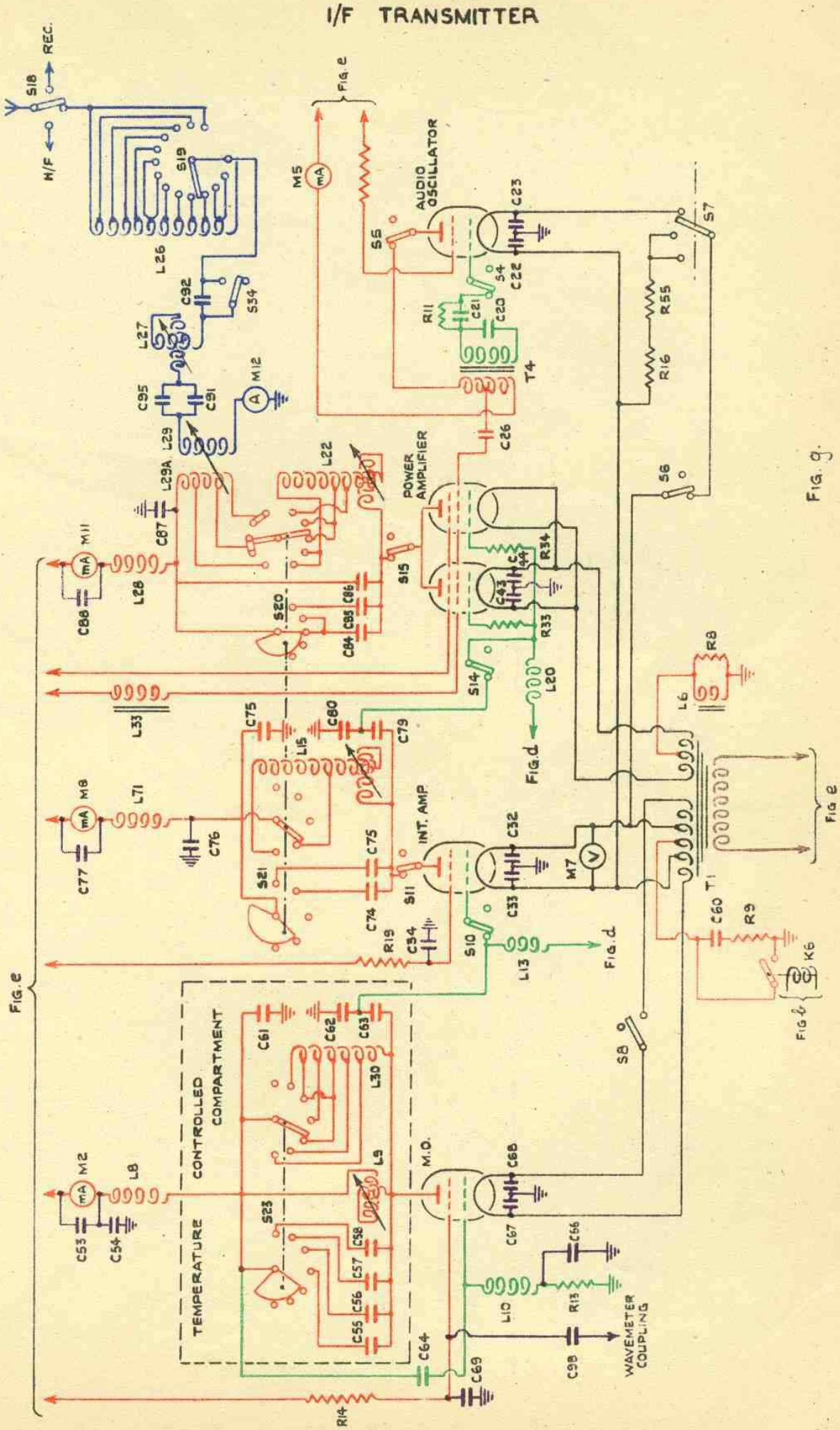



Fig. 9.

# TYPE TBL

## I/F TRANSMITTER

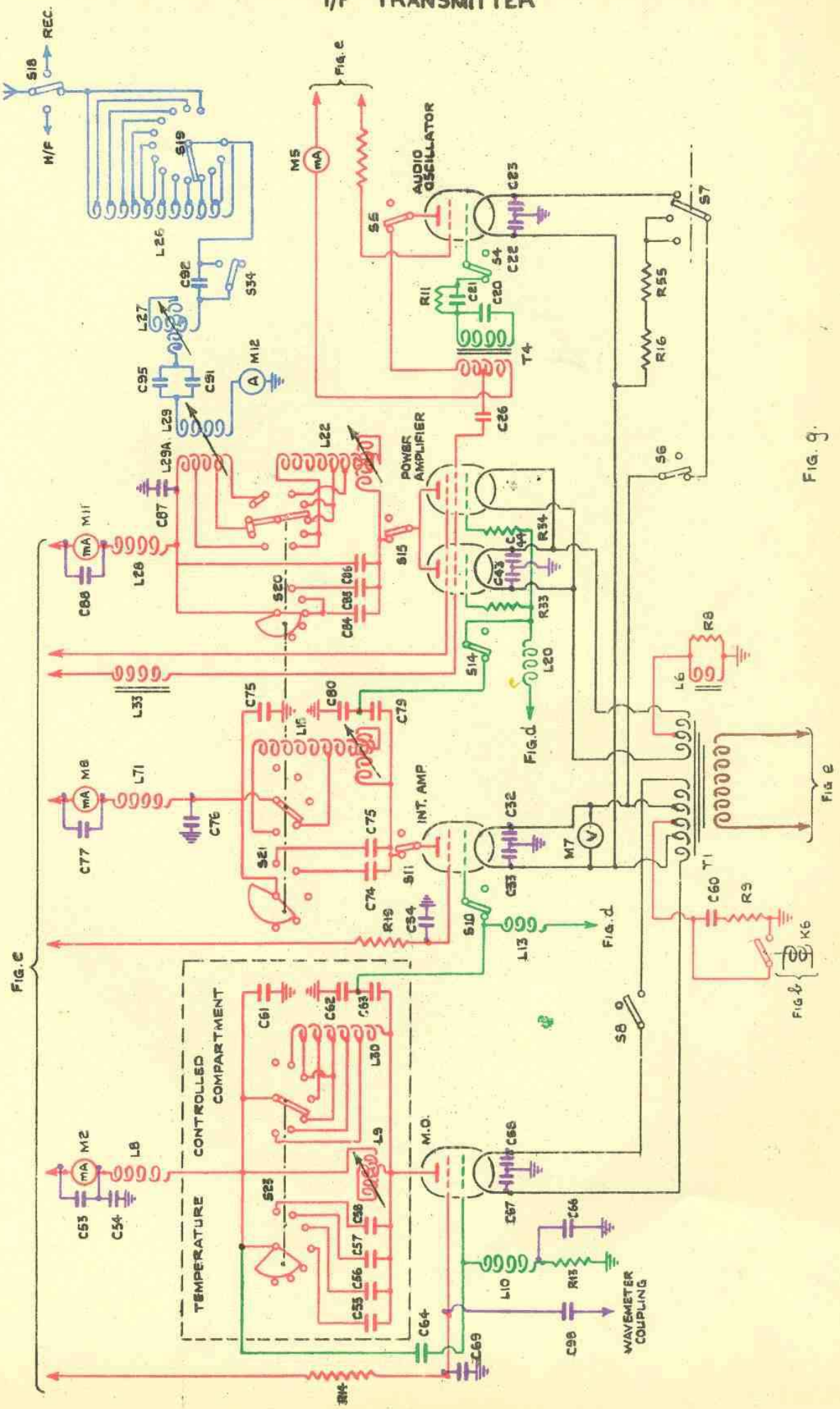



FIG. 9.